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Remarks

Thorough examination by the Examiner is noted and appreciated.

The claims have been amended as suggested by Examiner to clarify Applicants disclosed and claimed invention.

Support for the amendments is found in the original claims and the Specification including the Figures. No new matter has been added.

For example, support for the amended claims is found in the original claims and in the Specification, for example at paragraph 0017:

"In accordance with these and other objects and advantages, the present invention is generally directed to a new and improved electropolishing method for removing potential device-contaminating particles from a wafer. The method is particularly applicable to removing metal particles from via openings and/or trench openings formed in a dielectric layer on a wafer after the formation of a metal seed layer in the openings and prior to the

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electroplating of metal interconnects in the openings. The invention includes immersing the wafer in an electropolishing electrolyte solution and removing defects and particles from the seed layer by rotating the wafer in the solution. **Simultaneously, a pulsing or continuous electrical current is applied to the wafer to remove metal from the seed layer by electrolysis.** The method is effective in removing particles from via openings and trench openings of all sizes, including openings having a width smaller than about 0.2 μm ."

Premature Finality

Applicants respectfully request Examiner to WITHDRAW THE FINALITY OF THE ACTION. Applicants' note that Examiner has made final the most recent office action on numerous new grounds relying on numerous references of new prior art not previously of record, i.e., Bajaj, Ting, Bereza, and Hu et al.

Examiner claims that Applicants amendments necessitated new grounds of rejection, however, Applicants amendments largely incorporated dependent claim limitations into amended independent claims, and therefore clearly should have been expected or foreseen.

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Rather, Applicants clearly overcame the previously applied prior art including Section 102 rejections that necessitated Examiners application of new art.

Applicants reproduce relevant portions of the MPEP concerning
FINALITY OF OFFICE ACTIONS:

706.07 Final Rejection

Before final rejection is in order a clear issue should be developed between the examiner and applicant. To bring the prosecution to as speedy conclusion as possible and at the same time to deal justly by both the applicant and the public, the invention as disclosed and claimed should be thoroughly searched in the first action and the references fully applied; and in reply to this action the applicant should amend with a view to avoiding all the grounds of rejection and objection.

The applicant who is seeking to define his or her invention in claims that will give him or her the patent protection to which he or she is justly entitled should receive the cooperation of the examiner to that end, and not be prematurely cut off in the prosecution of his or her application.

706.07(a) Final Rejection, When Proper on Second Action

Under present practice, second or any subsequent actions on the merits shall be final, except where the examiner introduces a new ground of rejection that is neither necessitated by applicant's amendment of the claims nor based on information submitted in an information disclosure statement filed during the

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period set forth in 37 CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p). Where information is submitted A second or any subsequent action on the merits in any application or patent involved in reexamination proceedings should not be made final if it includes a rejection, on prior art not of record, of any claim amended to include limitations which should reasonably have been expected to be claimed. See MPEP § 904 *et seq.* For example, one would reasonably expect that a rejection under 35 U.S.C. 112 for the reason of incompleteness would be replied to by an amendment supplying the omitted element.

Moreover, Applicants amendments included no new subject matter that was not previously claimed and where most of the amendments involved incorporating limitations from originally presented claims.

Applicants therefore, respectfully request Examiner withdraw the Finality of the most recent action, to give Applicants a fair opportunity to distinguish their invention over the newly cited art, as they are entitled to do.

Claim Rejections under 35 USC 103

1. Claims 1-2, 13, 21-22, 24 and 26-27 stand rejected under 35 USC 103(a) as being unpatentable over Bajaj (US 2003/0201185) in view of Ting et al. (US 6,017,437).

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Bajaj disclose a method for removing organic contaminants from a seed layer in an electroplating apparatus where the substrate remains stationary and the plating solution is circulated to the cleaning surface and where a cleaning wave form is applied to the cleaning surface by applying a series of anodic and cathodic pulses to the seed layer (see Abstract; paragraphs 0017, 0020, 0022, 0023. Bajaj specifically teaches away from thinning the seed layer by teaching **removal of only the organic contaminants without removing an "significant" amount of the seed layer**, since removal of the seed layer will result in uneven plating in a subsequent planting process (see paragraph 0023; 0024). Bajaj also teaches **"slight etching" of the organic contamination" while not removing a substantial portion of the seed layer** (paragraph 0024). Bajaj also teaches applying pulses to **etch 41 Angstroms of the organic contaminants without etching the seed layer** (paragraph 0026). Bajaj also teaches cathodic pulses such that if any of the seed layer is removed then the cathodic pulses are **arranged to deposit material such that the seed layer is not "damaged"** (paragraph 0027). Bajaj also teaches that following the disclosed process **"there is not any substantial etching of the seed layer"** and that the disclosed

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anodic pulses operate to "**repel and desorb organics**" from the seed layer (paragraph 0028).

On the other hand, Ting teaches an apparatus for electroplating or electropolishing where a sleeve forming an electrolyte containment chamber mates with the wafer. Ting teaches that the wafer may be rotated or held stationary or oscillated during the electroplating or electropolishing process, depending on the medium (electrolyte) used:

It is generally an accepted practice to **rotate a wafer when it is subjected to certain processing medium**. The rotation ensures a more uniform distribution of the medium over the wafer surface. **Accordingly, the practice of rotating the wafer 35 on the wafer support 13 will also depend on the medium utilized in the chamber 11 and the effectiveness of its distribution for the process being performed. Thus, one approach is not to rotate the wafer.** However, where rotation of the wafer aids in the medium distribution, the wafer support 13 can be rotated by rotating the shaft 17. Although the speed of rotation is a design choice for the particular process being practiced, a typical range is 5-500 rpm (revolutions per minute). Furthermore, instead of rotating the wafer at a particular rpm, **the wafer can be oscillated (or agitated) back and forth.** It is appreciated that the present invention can be practiced by rotating (or oscillating) the wafer or the wafer support can remain stationary.

Ting also teaches a different cleaning process than Bajaj including deionized water cleaning and drying process for the

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wafer including prior to contacting the electrolyte:

"Once the electroplating process is completed and the electrolyte drained, de-ionized (DI) water is pumped and injected onto the surface of the wafer to wash it. Subsequently, nitrogen (N.sub.2) gas is pumped into the containment region 28 to dry the wafer prior to its removal from the chamber 10. **It is appreciated that the wafer 35 can be cleaned and dried a number of times, including prior to the introduction of the electrolyte. Typically, the cleaning and drying cycles are performed with the wafer support 13 positioned at the lower position.**"

Thus, there appears to be no apparent motivation to combine the teachings of Bajaj who teaches an electroplating apparatus where the **wafer is held stationary for cleaning organics from a seed layer surface without thinning the seed layer** with the teachings of Ting who teach that the wafer may be rotated, held stationary, or oscillated during an electroplating or electropolishing process, depending on the medium, and further teach a different cleaning method which involves deionized water and then nitrogen to dry the wafer prior to contacting with the electrolyte.

Nevertheless, even assuming arguendo a proper motivation for combination, such combination does not produce Applicants disclosed and claimed invention:

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"A method for removing **metal containing particles** from a wafer surface comprising damascene openings lined with a metal seed layer **to thin said metal seed layer** comprising the steps of:

providing an electrolyte solution comprising said metal;

immersing said wafer surface in said solution in spaced apart relation to an electrode and **rotating the wafer** in said solution; and

simultaneously supplying a pulsed electrical current to said wafer and said electrode to result in a net removal of a portion of said metal seed layer prior to electroplating said metal to fill said damascene."

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

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"A prior art reference must be considered in its entirety, i.e., as a whole including portions that would lead away from the claimed invention." *W.L. Gore & Associates, Inc., Garlock, Inc., 721 F.2d, 1540, 220 USPQ 303 (Fed Cir. 1983), cert denied, 469 U.S. 851 (1984).*

With respect to claim 13, Applicants reject Examiners assertion that the method of Baja would inherently remove metal particles from a copper layer. The method of Bajaj of **etching only organics** from the seed layer surface or by **desorbing or repelling them**" does not teach removing metal particles.

With respect to claim 21-22, Examiners assertion of a teaching of inherent **net removal** of the seed layer is rejected and Bajaj specifically teaches away therefrom.

With respect to claim 24, Applicants reject Examiner assertion that subquarter micron is inherent less than 0.2 microns.

"To establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so

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recognized by persons of ordinary skill." *In re Oelrich*, 666 F.2d 578, 581-582, 212 USPQ 323, 326 (CCPA 1981).

"In relying on the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex Parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990).

2. Claims 3, 7, 10, and 15 stand rejected under 35 USC 103(a) as being unpatentable over Bajaj in view of Ting et al., above, and further in view of Taylor et al. (US 2002/0056645).

Applicants reiterate the comments made above with respect to Bajaj and Ting et al.

The fact that Taylor et al. teach the use of polyglycol suppressors in a **pulsed current electroplating operation** to **achieve uniform filling** of recesses, does not further help Examiner in producing Applicants disclosed and claimed invention

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or establishing a *prima facie* case of obviousness.

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

3. Claims 17, 19, 23, 25, and 28 stand rejected under 35 USC 103(a) as being unpatentable over Bajaj in view of Taylor et al., above and further in view of Ting et al., above.

Applicants reiterate the comments made above with respect to Bajaj, Taylor et al., and Ting et al.

With respect to claim 17 and 19, Applicants reject any assertion of inherency by Examiner that the method of Bajaj et al. would inherently remove metal particles for a via opening. Nowhere does Bajaj et al. teach or suggest such a result.

"To establish inherency, the extrinsic evidence must make

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clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." *In re Oelrich*, 666 F.2d 578, 581-582, 212 USPQ 323, 326 (CCPA 1981).

"In relying on the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex Parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990).

4. Claims 20 stands rejected under 35 USC 103(a) as being unpatentable over Bajaj in view of Taylor et al., and further in view of Ting et al., above, and further in view of Bereza et al. (SU 1440636).

Applicants reiterate the comments made above with respect to Bajaj, Taylor et al., and Ting et al.

Even assuming arguendo, a proper motivation for combination, the fact that Bereza et al. **teach an electrochemical machining**

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method for machining tungsten where the release of hydrogen between anodic and cathodic pulses forms a passivation layer on the machined surface, does not further help Examiner in producing Applicants disclosed and claimed invention or establishing a *prima facie* case of obviousness.

5. Claims 13 stands rejected under 35 USC 103(a) as being unpatentable over Hu et al. (US 2003/0209448) in view of Uzoh et al. (US 6,492,262).

Hu et al. teach a polishing pad (article) with conductive fibers for contacting and polishing a surface providing mechanical abrasion in a polishing process (see Abstract; Fig 2; paragraph 0074, 0080, 0083).

Uzoh et al. disclose a **planarization method** where a wafer having a planarization layer is mounted on a rotating carrier which is pressed against a rotating polishing pad with electrochemical slurry while applying a current to the carrier and the planarization layer (see Abstract; Figures 4-7). An initial portion of the excess metal on the planarization (surface) layer is removed electrochemically while chemical

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mechanical removal is dominant in removing remaining portions (col 4, lines 34-66).

Even assuming *arguendo* a proper motivation for combining the teachings of Hu et al. with Uzoh et al., the fact that Uzoh et al., as cited by Examiner, teaches in the prior art defective seed layers where a portion of the seed layer and barrier layer are missing (see Figure 4, col 4, lines 1, to 9, and teaches that a defective filling layer is then formed as a result, does not further help Examiner in producing Applicants disclosed and claimed invention or establishing a *prima facie* case of obviousness.

"Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

6. Claims 15 stands rejected under 35 USC 103(a) as being unpatentable over Hu et al. in view of Uzoh et al., and further in view of Taylor (2002/0056645).

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Applicants reiterate the comments made above with respect to Hu et al., Uzoh et al., and Taylor.

7. Claims 16 stands rejected under 35 USC 103(a) as being unpatentable over Hu et al. in view of Uzoh et al., and further in view of Bereza et al. (Su 1440636).

Applicants reiterate the comments made above with respect to Hu et al., Uzoh et al., and Bereza et al.

8. Claim 22 stands rejected under 35 USC 103(a) as being unpatentable over Hu et al. in view of Uzoh et al., and further in view of Rathmore et al. (US 6,258,710).

Applicants reiterate the comments made above with respect to Hu et al. and Uzoh et al.

Even assuming *arguendo* a proper motivation for combination, the fact that Rathmore teaches copper seed layers having a thickness of 100 to 700 Angstroms, does not further help Examiner in producing Applicants disclosed and claimed invention or establishing a *prima facie* case of obviousness.

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Thus, the cited references, singly or in combination fail to make out a *prima facie* case of anticipation or obviousness with respect to Applicants independent claims, and therefore Applicants dependent claims.

Conclusion

None of the multiplicity of cited references, including newly cited references not previously of record, singly or in combination, disclose or suggest Applicants disclosed and claimed invention, nor recognize or provide Applicants solution to the problem that Applicants have recognized and solved by their disclosed and claimed invention:

"A method for removing **metal containing particles** from a wafer surface"

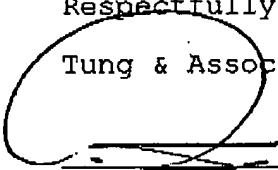
Based on the foregoing, Applicants respectfully request reconsideration of their claims and submit that the Claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

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In the event that the present invention as claimed is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

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